Flower and Fruit Abscission in Orchards

Nilda ERSOY
Selçuk University, Agricultural Faculty,
Horticultural Department,
42031, Konya/Türkiye,
nersoy@selcuk.edu.tr

Mustafa BEKTAŞ
Selçuk University, Agricultural Faculty,
Horticultural Department,
42031, Konya/Türkiye,
mbarsiv@gmail.com

Cumhur ERSOY
Akdeniz University, Vocational High School,
07070, Antalya/Türkiye,
cersoy@akdeniz.edu.tr

Abstract: A small part of flowers which occurs by blooming and have fruit set stay on tree till harvest in fruit trees. If all flowers transformed to the fruit the tree would not feed these, not to be completed developing and decreased their quality. Hence, both the tree and growers are affected negatively. Researches show that even have good fertilization and growing conditions most of the flowers and fruits abscise. In fruit culture abscission of the flower and fruit is four forms. These ones are; flower, small fruit, June and pre-harvest period abscission. Many factors effect flower and fruit abscission. These ones are; lack of the fertilization, inadequate nutrition, lack of the plant growth regulators, diseases, pests and abnormal environmental factors, respectively.
In this research, concerning reasons of flower and fruit abscission and the measures against these situations are evaluated.

Key Words: Flower, fruit, abscission

1- Introduction

Flower and fruit falls are one of the most important subject interest searchers and growers in fruit culture. These falls are called abscission in literature. Abscission is the sequence of events whereby a multicellular organ (e.g. leaf, flower, fruit, branch) becomes separated from the parent body. Abscission genetically programmed and control by plant growth regulators (Osborne 1989). When plants reached an apparent maturity and agedness stage fall their organs skin, branch, bud, leaf, flower etc as a development symptom.

Abscissions are not exclusion of dead tissues contrary an active disconnection event. Abscissions realize in different organs and different times as a result of cellular and chemical changes occur in abscission layer (Burak 1994).

As a rule, fall is postponed as long as an organ to continue in the physiological activity. However, physiological activity is complete, disease or physiological activity for any reason that the layout of the damaged organs can be seen that appears to fall (Kaynaş 2004).

As it is known in fruit culture to get any crop one of the first condition is blooming. Enough to get a product is required for adequate blooming. In a good fertilization and maintenance conditions 15-20% of apple flowers in the open, pears 8-15% , citruses 1-3%, plums 3-4.5% , grapes 20-30%, olives 1-5% , raspberries 70-80% (Kaynaş, 2004), avocado 0.2% (Anonymous 2007a) are a good yield when the fruit connected in this rates. Kiwi fruit, except that normally do not have the abscission and all the flowers to connect fruit (Anonymous 2007b).

2- Taxonomy of Flower and Fruit Abscission in Fruit culture

4 groups of flowers and fruit in the fruit growing in the abscission it is possible to collect. These are flowers abscission, small fruit abscission, June abscission and pre-harvest abscission.

2.1. Flower Abscission

The abscission occurs immediately after flowering. Why the lack of fertilization or damaged occur and in terms of the structure of the female organs are distorted, especially in deciduous flowers can be seen as rudimentary pistil. For example, 6% of pistachio in the flowers maturity yet to be accepted (receptivity) would die without access (Anonymous 2007c).

Atrophy of the female organ with olive abscission sometimes 80% is reached. The average is 2 weeks. In fruit trees such as avocado (abscission takes 3 weeks and almost all the abscission will perform (Anonymous 2007a) in this process in the time of full bloom to apply growth inhibitors like paclobutrazol or uniconazole cause vegetative implementation lead to increased generative development as the amount of product increases.

2.2. Small Fruit Abscission

The abscission happens 15-20 days later from flowers abscission. The fruit of the female organs are normal, but fertilization is disorder. Little or no developed embryos and endosperm did not occur. Nutrition disorders can also cause small fruit abscission. Auxin that flowers and small fruits inclusion abundantly increase abscission if it transports from abscission zone to other organs (Goldschmidt 1976, Goren and Goldschmidt 1970).

In addition, the seeds of small fruit, especially in the ethylene synthesis in the seed coat are effective in small fruit abscission (Anonymous 2007a).

2.3. June Abscission

At the figures 1 and 2 before and after June abscission with displays of the species of apple has been given. June abscission is seen about 1 month later from small fruit abscission. Fruits are the size of hazelnuts. That's because the very rapid growth and development of embryo and thereupon not to develop endosperm and embryo (Kaynaş 2004).

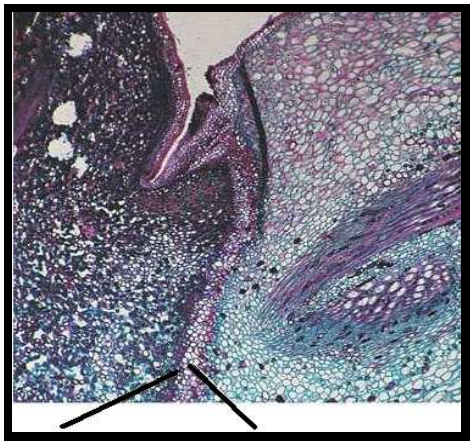
Figure 1 Apples before June abscission (15 mm) (Anonymous 2007d)

Figure 2 Apple after June abscission (21 mm) (Anonymous 2007d)

2.4. Pre-Harvest Abscission

The abscission is just before full maturity (Figure 3). In fruit peduncle abscission layer and protective layer occurs from cells that have thin membranes (Figure 4) and the tissue stays to the abscission.

Figure 3. Pre-Harvest abscission in apples (Anonymous 2007e)



Protective layer Abscission layer
Stem Fruit peduncle
Figure 4. Abscission layer and protective layer (Anonymous 2007f)

In the formation abscission layer the cell membrane are destroyed especially by cellulose and polygalactronase enzymes. Works are done in the direction to isolate the genes that synthesis by these enzymes (Burak 1994).

Destruction of cells in that layer during the abscission is performed by melting. Certain cells in this layer semi-permeability are reduced, all protoplasts lose, intra of cells fill with and soften.

In parallel with the softening pectin formation increases too in this parts. In this area vascular break off by mechanical effects and fruit abscission occurs (Kaynaş 2004).

Pre-Harvest fruit abscission is a problem directly affect the grower. What if grower will not give more importance to the rate of abscission and will be satisfied with fruit trees remaining or before pre-harvest abscission grower will pick them without get quality and full color. Indeed, in both cases as well as the farmer also negatively affects the national economy (Burak 1994). However, pre-harvest abscission to be stopped and harvest has been extended by delayed harvest and fruit will increase marketing opportunities.

The causes of pre-harvest abscission; before harvest hot-cold weather, excessive and late fertilization of nitrate, drought or high groundwater, fertilization and seed fewness, inadequate of boron and magnesium deficiencies, inadequate of plant growth regulators, especially abscisic acid is concentrated, auxin deficiency and is the increased synthesis of ethylene.

Maintenance work to be done regularly is not enough to prevent pre-harvest abscission. To prevent this abscission should be done applications of synthetic auxin (Kaynaş 2004).

If abscissions are not enough in horticulture by making flowers or fruits thinning vegetative and generative balance of the tree can be provided. For this purpose, thinning hand, chemical substances (dinitro compounds), and with growth regulators (auxins) is done (Kaynaş 2004).

If abscission is more the growth realized as vegetative and the productivity will decrease. In this case the prevention of abscissions, or in a balanced manner to realize such as the plant water balance, nutrition programs and pruning techniques of cultural actions as appropriate to be done, to increase fertilization the bees in the garden and the use of growth regulators (auxins and gibberellic acid (GA) is possible (Kaynaş 2004).

3. Factors Play a Role in Flower and Fruit Abscission

- In general, flowers and fruit abscissions in fruit trees;
- Flaw of fertilization,
- Inadequacy of nutrition,
- Plant growth regulators for the flaw,
- Diseases of and harmful,
- Environment and culture conditions have emerged ahead of abnormalities.

3.1. Effects of Fertilization Flaws to Abscission

Fertilization flaw is effective especially in flowers and small fruits abscission. The flowers are not fertilized and small fruits that not enough fertilized abscise. This situation, abscised fruits in numbers of full and empty seed can be explained by taking into consideration. For example, small fruit abscission in Masaya apple, 5% full, 80% empty seed and 15% in the dead ovis, small fruits in these rates remaining on brunch respectively, 89%, 1% and 10%. This study clearly shows the impact on fertilization is abscission (Özbek 1977).

3.2. Effect of Nutrition in Abscission

3.2.1. Effect of Water in Abscission

Researches prove between the amount of water with the tree and fruit abscission there is an interest. The leaves that have a greater osmotic power to take the water from fruits be the cause of fruit abscission. Water flaw makes fast the fruit abscission in Spring and summer months. Moreover, the low air humidity, rise of temperature, more lighting and especially dry winds increase transpiration and encourage abscission (Özbek 1977, Coutanceau 1962, Chandler 1957).

On the other hand, the impact of the flaw of the water varies according to physiological status and maintenance conditions. Fruit abscission in dry regions is more than rainy regions. Excessive water increases abscission like inadequate water. The trees have an optimal water capacity. Negative impact is seen on top of this.

Observations have seen in the years of plentiful rainfall till June abscission like dry years abscission increase. This effect is estimated to be indirect. Excess amounts of water to speed up the development of shoot hence water causes abscission of the opponent fruit (Burak 1994).

3.2.2. Effect of Mineral Materials in Abscission

In the period following fertilization the formation of seeds is very fast in this period especially nitrogen and phosphorus needs. Because of this, nitrogenous fertilization is important for the abundant flowering and despite of good fertilization conditions not fruit connected trees (Özbek 1977, Chandler 1957).

Between vegetation beginning and June abscission stage nitrogen needs very much because of cell division. About 60% of annual nitrogen consumption of trees has emerged 3-4 months. According to

observations, a very weak given the small amount of nitrogen in growing trees, fruits to reach the harvest can not provide. On the other hand, the strong improvement in the much amount of nitrogen in fruit trees will fall. Because the maximum amount to be used for development vegetatively and sufficient nutrient to reduce for fruit development in the medium (Burak 1994).

3.2.3. Effect of Carbohydrates on Abscission

Carbohydrates are indispensable sources of energy in the formation of new tissue, and for all substance exchange. In this regard, especially in abscission periods of fruit trees an appropriate metabolic activity should be provided. Good nutrition by carbohydrates provides better to hold fruits (Özbek 1977).

3.3. Deficiencies in Plant Growth Regulators

3.3.1. Effect of Auxins in Abscission

Auxin, abscission in the region by reducing the sensitivity of cells to ethylene is delayed fruit abscission.

Fruits begin to develop in the first circuits in excess of the auxin amount that produced by seed and the rate decrease or increase depending on the development of seed. Flower and fruit of abscissions of less auxin to occur on the circuit, the circuit in more than has been found to stop (Lepold and Kridemen 1975, Chandler 1957, Westwood 1978). Implementation of the NAA in the time of early fruit development encourage ethylene production and allows small fruit abscission (Anonymous 2007g).

3.3.2. Effect of Ethylene on Abscission

Ethylene is naturally generated during growth, development and maturation in plants. It is thought ethylene coordinates abscission, maturity and death process. Ethylene is produced in any part of the plant which is as a result of injury, and by reason of interact with other organs increase fruit abscission. When auxin level is low synthesis of ethylene increases and begin the process of abscission. In the case of the high level auxin ethylene is ineffective in the abscission. (Anonymous 2007g).

3.3.3. Effect of Abscisic Acid in Abscission

ABA (Abscisic Acid) is a natural plant growth inhibitor and accelerates abscission. When ABA application is made in sour cherry abscission layer development fasted and cellular changes was found (Zucconi et al. 1969).

3.4. Effects of Harmfuls and Diseases on Abscission

Diseases (Figure 5) and harmfuls cause abscission in significant amounts in fruit development process.

Figure 5. Because of Phytophthora in citrus abscission (Anonymous 2007h)

3.5. Abnormalities that Emerging in Environment and Culture Conditions

3.5.1. Climate Factors

3.5.1.1. Temperature

In the conditions of appropriate nutrition development of fruit accelerates by increasing temperature. However, after a certain level (39 ^{o}C) development stops. Temperature is also affected root development. Water absorption speed of the roots increases until 30 - 40 ^{o}C and decreases by impairment of the cells over the degrees. In a very cold region in the spring, between the tree roots and over soil parts a different vegetative situation may be formed and important abscission can occur. The cold is very intense, especially sensitive to the causes of death of flowers and small fruit (Westwood, 1978). In this way, can generate very heavy production losses. Crane (1954) after 2 days of cold damage to the 2,4,5-T Tilton apricot varieties of fruit abscission of implementation is reduced, damaged most of the fruit was also determined that continued development.

3.5.1.2. Wind

Especially in hot and dry wind as sweating increases significantly. Especially in the arid lands of this abscission is accelerated (Burak, 1994).

3.5.1.3. Rain

It rains following a drought, will usually result in smaller fruit abscission. Furthermore, especially in the rains period of full bloom, by prevent fertilization causes abscission (Burak, 1994).

3.5.1.4. Soil Factor

Organic matter status and richness in minerals of soil is effective to nourish the tree. Particularly in the strong soils determined that the flowers and fruits abscission are much by overdo fertilizing too (Ülkümen, 1973).

4. Measures for Flowers and Fruit Abscissions

4.1. Measures in the Field of Nutrition

Works in this area are intended to provide a balanced nutrition system in the tree. These measures will be made either directly applications on the tree or by soil can be obtained.

4.1.1. Applications on the Tree

4.1.1.1. Pruning

In the head of this practices there is pruning. By removing a portion of branches as a result reduced the number of flowers and small fruit, competition is lighted between them and better nutrition is provided. Thus each element more carbohydrate, nitrogen and hence own growth regulators produce materials.

Time to prune is also important. If done early enough flowers is very good and quite benefits and better to be feed sexual cells show less tendency to abscission (Burak 1994).

Moreover, pruning air and light status makes the appropriate correcting to suck carbon in all trees. However, to obtain positive results out of the branch must be chosen well. Violence of pruning must be set according to species and growth conditions of the tree (Chandler 1957, Westwood 1978).

4.1.1.2. Effect of Rootstock

It is estimated that rootstocks effects indirect in fruit abscission. Direct effect of encouraging or reduction the growth of exile. The effect of rootstocks is different in strong and dwarf rootstocks.

Developing of roots in dwarf rootstocks less compared to powerful rootstocks and they can benefit less from the nutrients. Therefore, shoot growth is limited in dwarf rootstocks. But as a natural result of competition between fruit and shoot decreases. Particularly it is frequently observed that as a result of over-fertilization shaking is occurred in trees that in powerful soils and grafted powerful rootstocks (Ülkümen 1973). But the purchase of mineral materials is limited in dwarf rootstocks such as the purchase of water. Therefore, irrigation is very important in dwarf rootstocks (Burak 1994).

4.1.2. Applications Made Through Soil

The processes are done through soil that flowers and fruits to take control of abscission for the irrigation, drainage, fertilization and maintenance of soil.

A careful irrigation in all critical periods of continuous and to get into all roots in suitable style can reduce abscissions significantly (Özbek 1977, Ülkümen 1973, Countanceau 1962).

Usually, in the following period of fertilization, because of fast seed development in fruits, trees needs especially nitrogen and phosphorus in this period. Therefore, nitrogen fertilization is important in abundant flowering and even though fertilization conditions are good not kept fruit, and in these cases 3 weeks before bloom giving of nitrate fertilizer often reduces or prevents abscission (Özbek 1977).

4.2. Measures in the Field of Plant Growth Regulators

In 1939 the first studies on this subject were made by La Rue. La Rue has found the defoliation of the coleus plant delay using synthetic plant growth regulators. This important invention has been referred to many researchers on prevention abscission of different organs in different plant species by the synthetic plant growth regulators (Özbek 1971).

Naphthalene Acetic Acid (NAA) and derivatives are used as intense in pre-harvest abscission. NAA is applied 1 week ago from harvest; its effect begins after 3-4 days carry on 3-4 weeks. NAA is used 10 ppm in apples, pears at 5 ppm and 2.5 ppm in Williams's pears. Fenoxi acetic acid and derivatives, 2,4-D, 2,4,5,-T and 2,4,5-TP have used 2-3 weeks ago from the harvest. The effects start after 5-7 days, and lasts 3 months (Kaynaş 2004).

10 ppm in citrus fruits, 3-5 ppm in Stayman and Winesap apple cultivars and in the pear 3 ppm 2,4-D; citrus for 5 ppm 2,4,5-T and apple for 2,4,5-TP used. Aminozid (Alar, B9, SADH) is a substance effective of antigibberellin and inhibitor regress that internal ethylene synthesis. It slows fruit maturity, delays abscission and extend harvest period. Alar is used in intended amount because there is no negative impact on ability of storing. In fact the fruit inside watery spots and the fruit scald reduces, the flesh hardness is sustained and the formation of the top colors is improved. But it is applied in very early term of fruit is smaller. Usually 2-3 weeks before harvest and in the rate of 0.1-2% (Kaynaş 2004). Auxin applications sometimes give different results at the level of variety. For example, the 2.4-D application are able to achieve results in Staymen Winesap and Winesap apple cultivars, there is no any change in Golden Delicious and Mc Intosh apples (Burak 1994).

Serr and Forde (1952), In Peerless almond cultivar, when the first coat is seen to crack 10 ppm 2.4-D and 20 ppm 2,4,5-trichlorophenoxy propionic acid applied and observed fruit application has been blocked and due to there is no tree damage in any record (Burak 1994).

WookJae et al. (2006) determined in Tsugaru apple cultivar to control pre-harvest fruit abscission applied 125 mg AVG/l (aminoethoxyvinylglycine) and have seen flesh hardness increased, there is no pre-harvest abscission occurred and harvest delayed 10 days from normal time.

It is understood that the reason of fruit abscission of a group of Italian plums (*Prunus salicina* L.) abortion of embryo. Abscission is significantly reduced by the spraying of 5-20 ppm 2,4,5-TP before 2 weeks from seed hardening (Westwood 1978).

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